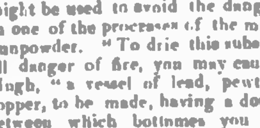
THE HISTORY OF HEATING BY HOT WATER.

Sir Hugh Platt, who was the first to point out steam as a medium for heating the air of a room, suggested that hot water might be used to avoid the danger then run, in one of the processes of the manufacture of gunpowder. "To drie this substance without all danger of fire, you may cause," says Sir Hugh, "a vessel of lead, pewter, latten, or copper, to be made, having a double bottome, between which bottomes you may convey scalding water at a pipe, which water may be also heated at another roome, and then you may lay your powder upon the uppermost bottome till it be drie, and when the water beginneth to cool, you may let it out at a cock in the bottome of the vessel, and soe give passage for more scalding water by another cock." And in another part he says, "a vessel may be made to brew or boil in, by making a fire under a brass boiler, *a*, fig. 1, and conveying the steam or water into a wooden tub or receptacle, *b*." Rudolph Glanber, also, proposed heating a brewer's vat, by a brass ball filled with water and placed in a fire, a pipe from which was carried into the vat. "A contrivance," says Hooke, "which if prosecuted, might be very beneficial to those who require great quantities of hot water, by enabling them to use wooden casks instead of copper boilers."

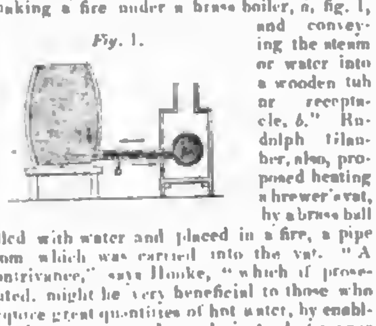
Fig. 1.



Sir Martin Triewald, a Swede, who lived for many years at Newcastle-on-Tyne, before he finally settled in his native country, about 1716, described a scheme for warming a greenhouse by hot water, instead of by fermenting vegetable substances. The water was boiled outside of the building, and then conducted by a pipe into chambers formed under the plants.

Prior to the French Revolution, an ingenious application of the same medium for diffusing heat was made by M. Bonnemain, in an apparatus to hatch chickens, to supply the Paris market. In this water-stove, a transverse section of which is shewn in fig. 2, ; *a*, boiler, on its furnace, furnished with an *expansion-rod* to regulate the opening and shutting of the ash-pit door; *d*, a pipe for supplying water to the boiler, and keeping the pipes always filled with water; *o*, stop-cock, for regulating the quantity of the ascending hot water; *b*, pipe of communication between the boiler and heating-pipes, *c*, which traverses the hatching-chamber, *x*, with a slope towards the boiler, into which it is inserted, and its lower end carried nearly to the bottom of the vessel. The air disengaged from the water by boiling, and which would accumulate in the tubes and obstruct the circulation of the hot water, escapes by the pipe, *i*, and the water that rises along with it from the tube falls in the receiver, *k*.

Fig. 2.



As the water in the boiler gets warm, and becomes specifically lighter, it rises upwards in the pipe *b*, and its place is occupied by the colder and heavier water, which flows from the pipe, *c*, and enters the boiler at its lower extremity, *e*. A current is thus established from the boiler upwards, through the pipe, *b*, and then downwards, through the range of pipes, *c c*, into the boiler, with a velocity depending on the difference between the temperature of the water in the boiler, and that in the descending or heating-pipe at its insertion into the boiler. By this means a very equable temperature was kept up in the series of compartments in which the eggs were placed to be hatched.

For many years after this period, M. Bonnemain was in the habit of describing his apparatus to others, and a few years later a good account of it, explained by figures, was given in a French publication.

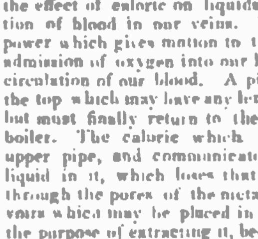
About 1812, hot water was used at St. Petersburg in the manner practised by Triewald; and shortly afterwards, in the same capital, by Count Zubow, in a similar but more roundabout method. The water made to occupy the space commonly filled by the fermenting substances, was heated by steam raised in a boiler placed on the outside of the conservatory. It is not clear whether this was before or after Mr. Braithwaite, at Kendal, warmed his counting-house by a small rectangular boiler, having its furnace included in a rectangular cast-iron case, which had the appearance of a chest placed against the wall. From the boiler a small pipe proceeded to the condenser, which was a copper vessel, 18 inches in diameter, placed under a double writing-desk. The condenser was formed on the plan of the improved cylindrical refrigeratories. A very small quantity of steam was allowed to escape at the top, which was however condensed against the lid, so that none of it escaped into the room. The steam gave out its heat to the water in the condenser; which was found, when once warmed, to retain the heat for many hours.

The Marquis de Chabannes, in 1816, introduced M. Bonnemain's method into this country; and in drawing the public attention to the hot-water system he claimed the merit of being its inventor. "The most perfect definition I can give of it," says the Marquis, "is by comparing a boiler to the human heart, and the effect of caloric on liquids to the circulation of blood in our veins. The fire is the power which gives motion to the water, as the admission of oxygen into our lungs causes the circulation of our blood. A pipe is placed at the top which may have any length or winding, but must finally return to the bottom of the boiler. The caloric which rises into the upper pipe, and communicates itself to the liquid in it, which loses that heat as it flows through the pores of the metal, or any reservoirs which may be placed in its passage for the purpose of extracting it, becomes gradually colder, and in that state pressing on the rarefied pipe which issues from the top of the boiler, re-enters at the bottom in proportion to what goes out above—thus causing a continual circulation; and the liquid coming in contact with the fire at a colder temperature, and besides with friction extracts a still greater portion of caloric."

In reducing his speculation to practice, he proposed to fix a small boiler behind the kitchen fire, and connect it by two pipes with a cylinder, containing twenty or thirty or more small pipes, open at both ends, and surrounded with hot water. This cylinder he placed under the stairs. The rarefaction in the small open pipes produced a current of warm air in the staircase, and the water which was cooled in the cylinder falling into the boiler, forced the warmer water upwards into the cylinder with a continuous circulation.

Since his time, warming by hot water has been much extended, and some variety introduced into the apparatus. That indicated by fig. 3 heats by the circulation of the water, and by warm air in the manner of a stove. The furnace is contained within the boiler, and its flue passing through it at top, is led by a 9-inch pipe, *i*, into the smoke-flue in the wall. The cylindrical boiler, *c*, is surrounded by a brick wall, *r*, leaving a space of four inches round it, which is covered in at top, and forms a small air-chamber. Into this inclosed space the air is admitted from a culvert, *v*, which communicates with the atmosphere under the porch in front of the building, and rising in the circular cavity, is heated by contact with the external faces of the boiler, and finally flows through the valved openings, or regulators, *m*, into the hall.

Fig. 3.

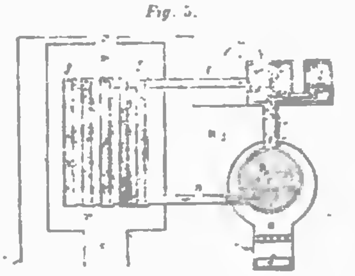


The hot water for warming the passages and staircases is conveyed from the boiler by the pipe, *a*, fixed under the ceiling of the basement-floor, with branches, *b d*, carried to each end of the building, which terminate in a series of heating-pipes, *s s*, arranged as shewn in fig. 4. These pipes are inclined from their point of junction, with the branch pipes to the exit by the descending pipe, and the whole are inclosed in a case, *u*, that has the bottom perforated with holes, to allow the cold air to rise and come in contact with the hot pipes, and then to percolate, when heated, through the holes made in the top of the case into the passages in the floor above, *o n*, the descending pipe from each heating-case connected with the return-pipe, and inserted in the bottom of the boiler. Small cocks, *n*, placed at the highest points, to emit the air that is extricated from the water. The mean temperature of the enclosed pipes Mr. Bramah stated to be 185°, when the temperature of the water in the boiler was 270°.

Fig. 4.

Mr. Manby's apparatus is a good example of flat parallel, heating surfaces, arranged as a hot air-stove. It is shewn in fig. 5, *c*, a cylindric boiler placed over a furnace, *a*, a pipe rises from the upper part, and terminates in a square inclosed vessel, from which a pipe, *e*, branches to the upper end of a series of flat hollow vessels, *f f*, that communicate with each other; another pipe, *u*, on their lower end, forms a communication with the bottom of the boiler. The flat hollow vessels are inclosed in a chamber, *x*, into which the cold air is admitted through an opening in its floor, and the heated air is conveyed through an opening, *r*, in its roof into channels, which distribute it at the points where it is wanted. The water is supplied to the boiler from a reservoir, *d*, and the water, which may be expelled by the expansion from heat, is conveyed by the small pipe, *u*, into a vessel, *s*, which forms the bottom of the ash-pit, to assist by its evaporation, as Mr. Manby thought it would, the combustion of the fuel placed on the grate over it.

Fig. 5.



The operation of this apparatus is very simple. The water heated in *c*, flows through *e*, into the air-heaters, *f*, where it is cooled by the current of cold air rising through the opening, *u*, and falls to the lower part of the heaters into a pipe, *a*, which conducts it to the lower part of the boiler, and by this means a continued stream of hot water flows from the boiler into the heating vessels, and preserves their surfaces at a certain temperature.

There is no practical objection to this neat and compact apparatus, except the greater difficulty of keeping the joints in order, when compared to a similar arrangement, where pipes are substituted for the flat vessels.

The preceding methods shew the ventilating and warming processes to be kept separate,